SECTION 3.3

DEGREASING - COMMERCIAL

(Updated February 1990; Reissued October 1997)

EMISSION INVENTORY SOURCE CATEGORY

Cleaning and Surface Coatings / Degreasing - Commercial

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION

220-214-8102-0000 (46854) Commercial Degreasing - Synthetic Solvents

220-214-8150-0000 (46847) Commercial Degreasing - Petroleum Solvents

METHODS AND SOURCES

This category is used to inventory the total organic gas (TOG) emissions from solvents used in degreasing operations at automotive repair shops. ***Commercial Degreasing - Synthetic Solvents*** includes TOG emissions from synthetic solvents such as methylene chloride and orthodichlorobenzene. ***Commercial Degreasing - Petroleum Solvents*** includes TOG emissions from petroleum solvents such as Stoddard solvent and mineral spirit solvents.

Emission estimates for 1983, described below, were updated to 1987 (Tables I and II) by using growth factors ranging from 0.340 to 2.453. These growth factors are used for forecasting by the Emissions Inventory Branch, ARB, and are assumed to be representative of the automotive services increase.[1]

The solvents used by the auto repair shops are commonly Stoddard solvent (a petroleum product) or mineral spirit solvents. These solvents are used in cold degreasers for cleaning parts to facilitate inspection and repair. Some auto repair shops have immersion cleaners containing synthetic solvents. According to the Safety-Kleen Corp.,[2] a major supplier, the synthetic solvent fraction contained in Safety-Kleen immersion units consists of 29 percent orthodichlorobenzene and 29 percent methylene chloride by volume. The remaining 42 percent are non-volatile compounds and are not included in emissions calculation.[2]

The procedure used for determining the emissions from degreasing operations at automotive repair shops was developed by Eureka Laboratories, Incorporated.[3] Emission rates for a standard parts washer by Safety-Kleen and a typical non-Safety-Kleen parts washer were derived based on information from the Safety-Kleen Corporation[2] and EPA,[4] respectively.

The Environmental Protection Agency (EPA)[4] has estimated emissions from the average maintenance type cold degreaser as 1.45 lbs per day per unit. The Safety-Kleen Corporation[2] estimated an average of 1.3 degreasing units per automotive repair shop. Based on these data, the emission factor is 1.89 lbs TOG per day per shop for automotive repair shops using non-Safety-Kleen degreasers.

The emissions from non-Safety-Kleen units were calculated by applying the emission factor of 1.89 lbs TOG per day per shop to the total number of automotive repair shops that are using non-Safety-Kleen degreasers. The number of repair shops that use non-Safety-Kleen degreasers was estimated from the total number of licensed auto repair shops provided by the California Bureau of Automotive Repair[5] and the data on the number of repair shops that are using Safety-Kleen degreasers supplied by the Safety-Kleen Corporation.[2]

Emissions from Safety-Kleen degreasers were estimated based on the number of Safety-Kleen units, the amount of solvent consumed, the amount of solvent recycled, and the density of the solvent.

The Safety-Kleen Corporation[2] provided 1983 data on: 1) number of Safety- Kleen units in each county broken down into machines using mineral spirit solvents and immersion cleaners using synthetic solvents; 2) total amount of solvents used in the state; 3) total amount of solvents recycled in the state; and 4) density of solvents used. The amount of solvents emitted from Safety-Kleen machines is assumed to be equal to the amount used minus the recycled amount.

ASSUMPTIONS

1. The solvents used in parts washers are mainly Stoddard solvent or mineral spirits with an estimated density of 6.7 lbs per gallon.

2. The synthetic solvents used in immersion cleaners serviced by Safety-Kleen Corporation are orthodichlorobenzene and methylene chloride with an average density of 10 lbs per gallon.

3. Degreasers are completely closed during non-working hours.

4. Auto repair shops operate eleven hours per day, six days a week (312 days per year).

5. Synthetic solvents are exclusively used in Safety-Kleen immersion cleaning units for degreasing at auto repair shops.

COMMENTS AND RECOMMENDATIONS

The quantity of degreasing solvent estimated by the Eureka Lab method is the best available method. The Eureka Lab method may not reflect the actual solvent usage in each county. A better method would be to survey all automotive repair shops in a given county. If such district data are available, they should be evaluated for use in the inventory.

TEMPORAL ACTIVITY

The annual activity is uniform throughout the year. Weekly activity is from Monday through Saturday. Daily activity is from 7:00 a.m. to 6:00 p.m. (It is assumed that the cold degreasers are closed during non-working hours and emissions are therefore negligible).

SAMPLE CALCULATIONS

A. Emissions from auto repair shops using Safety-Kleen washers.

The Safety-Kleen Corporation provided 1983 data on: a) mineral spirits and immersion cleaner solvents used and recycled statewide; b) number of Safety-Kleen machines using mineral spirits and immersion cleaner solvents for each county; c) the synthetic solvent fraction (58%) contained in immersion cleaners; and d) density of mineral spirits solvents (6.7 lbs/gal) and immersion cleaner solvent (10 lbs/gal).

According to Safety-Kleen Corporation, about 77% of the Safety-Kleen (S-K) machines using mineral spirit type solvents are used in automotive repair shops and about 90% of the S-K machines using immersion cleaner solvents are used in automotive repair shops. The rest of the machines are used for mining and other industrial degreasing operations.

1. ***Commercial Degreasing - Petroleum Solvents:*** The amount of mineral spirits emitted from Safety-Kleen machines is calculated as follows:

(Amount of mineral spirits (M.S.) used in CA in 1983) - (Recycled Amount)

= Amount of M.S. emitted in CA in 1983

(3,556,425 gal) - (2,548,326 gal) = 1,008,099 gal

$$\frac{1{,}008{,}099 \text{ gal} \times 6.7 \text{ lbs/gal}}{2{,}000 \text{ lbs/ton}} = 3{,}377 \text{ tons/yr of mineral spirits emitted in CA in 1983}$$

About 77% of the total mineral spirit emissions in CA come from auto repair shops, therefore:

(3,377 tons/yr) x (77%) = 2,600 tons/yr of mineral spirits emitted from auto repair shops in CA in 1983

Amount of M.S. solvent emitted/machine/yr

$$= \frac{\text{Amount of M.S. solvent emitted in CA/yr}}{\text{Total number of machines in CA using M.S.}}$$

$$= \frac{2{,}600 \text{ tons/yr}}{31{,}682 \text{ machines using M.S. x } 77\%}$$

$$= 0.1065 \text{ tons/machine/yr}$$

Using Los Angeles County as an example to determine county-wide estimate of the solvent or TOG emissions from mineral spirits used in Safety-Kleen machines, calculation is as follows:

According to Safety-Kleen Corporation, Los Angeles County has a total of 10,760 Safety-Kleen machines. Of this total, 90% use mineral spirit solvents and 10% use immersion cleaner solvents. Based on this information, the total amount of mineral spirits lost or emitted per year in L.A. is estimated.

(# of Safety-Kleen machines in L.A.) x (Percent using M.S) x
(Amount emitted/machine using M.S./yr)

= Total amount of M.S. emitted/yr in Los Angeles.

10,760 machines x 90% x 0.1065 tons per machine = 1,031 tons/yr emitted.

The total emissions from mineral spirit solvents used in both Safety-Kleen machines and non-Safety-Kleen machines correspond to the total TOG emissions for ***Commercial Degreasing - Petroleum Solvents***.

Therefore, the 1,031 tons/yr emissions from mineral spirit solvents used in Safety-Kleen machines will be added to the emissions from mineral spirit solvents used in non-Safety-Kleen machines (estimated under B of Sample Calculations) to get the total emissions for ***Commercial Degreasing - Petroleum Solvents***.

2. ***Commercial Degreasing - Synthetic Solvents:*** The amount of Immersion Cleaner (I.C.) solvents emitted is calculated as follows:

(Amount of I.C. solvent used in CA in 1983) - (Recycled Amount) x (Fraction of synthetic solvent in I.C. solvent)
= Amount of I.C. solvent lost or emitted in CA in 1983.

(143,000 gallons) - (108,000 gallons) x (58%) = 20,300 gal

$$\frac{\text{(Amount of I.C. solvent emitted in CA in 1983 in gal)} \times \text{(Density of I.C. solvent in lbs/gal)}}{\text{2,000 lbs/ton}} = \text{Amount of I.C. solvent in tons/yr emitted in CA in 1983}$$

$$\frac{\text{(20,300 gal)} \times \text{(10 lbs/gal)}}{\text{2,000 lbs/ton}} = 101.5 \text{ tons/yr}$$

About 90% of the Immersion Cleaner solvent emissions in CA come from auto repair shops, therefore:

(101.5 tons/yr) x (90%) = 91.4 tons/yr of I.C. solvents emitted from auto repair shops in CA.

Amount of I.C. solvent emitted/machine/yr

$$= \frac{\text{Amount of I.C. solvent emitted in CA/yr}}{\text{Total number of machines in CA using I.C. solvent}}$$

$$= \frac{91.4 \text{ tons/yr}}{\text{3,571 machines} \times .90}$$

$$= 0.0284 \text{ tons/machine/yr}$$

Safety-Kleen Corporation reported that Los Angeles County has 10,760 Safety-Kleen machines, of which 10% use I.C. solvent. Based on this information, the amount of I.C. solvents emitted per year in L.A. is estimated.

(Number of Safety-Kleen machines in L.A.) x (% of machines using I.C. solvent) x (I.C. solvent emitted / machine using I.C./yr) = Total amount of I.C. solvent emitted/yr in Los Angeles.

(10,760 machines) x (10%) x (0.0284 tons) = 30.56 tons/yr

The emissions from I.C. machines (30.56 tons/yr) correspond to the total synthetic solvent emissions for ***Commercial Degreasing - Synthetic Solvents***.

B. ***Commercial Degreasing - Petroleum Solvents:*** The emissions from auto repair shops using non-Safety-Kleen (non-SK) machines are calculated as follows:

According to Safety-Kleen Corporation, Los Angeles has approximately 10,760 total S-K machines. Of this total, about 90% use mineral spirit solvents. Of the total Safety-Kleen machines using mineral spirit solvents, about 77% are used in auto repair shop degreasing. Safety-Kleen estimates that there is an average of 1.3 machines per auto repair shop. The Bureau of Automotive Repair (BAR) reported the total number of licensed automotive repair shops in each county. According to BAR, there are 38,012 licensed auto repair shops in CA and 10,754 auto repair shops in L.A. County. Based on these data, the number of repair shops using Safety-Kleen units and non-Safety-Kleen units can be estimated for Los Angeles County.

$$\frac{\text{(10,760 Safety-Kleen machines)}}{\text{(1.3 machines/auto repair shop)}} \times (90\%) \times (77\%) = \text{(5,736 auto repair shops using S-K machines)}$$

(10,754 total automotive repair shops in L.A.) - (5,736 shops using S-K machines)

= 5,018 shops using Non-Safety-Kleen machines

NOTE: In estimating the number of shops using non-Safety-Kleen machines, only S-K machines using mineral solvents (a petroleum solvent) were included in the calculation because of the assumption that synthetic solvents are used solely by S-K immersion cleaners and therefore non-S-K machines use only mineral spirit solvents.

Using the emission factor of 1.89 lbs TOG/shop/day, the emissions from non-Safety-Kleen machines in L.A. are calculated as follows:

$$\frac{\text{(5018 shops using Non-SK) x (1.89 lbs/shop/day) (312 days/yr)}}{\text{2,000 lbs/ton}} = 1{,}480 \text{ tons/year}$$

Then, sum the mineral spirits emissions from Safety-Kleen units and Non-Safety-Kleen units to get the total emissions from ***Commercial Degreasing - Petroleum Solvents***.

1,031 TPY Safety-Kleen emissions + 1,480 TPY Non-Safety-Kleen emissions
= 2,511 tons/year

REFERENCES

1. Air Resources Board, Technical Support Division, Emission Inventory Branch Forecasting Section. Growth Scenario TND85, Control Scenario CS1985 (February 23, 1990).

2. Data provided by Safety-Kleen Corporation, (312) 697-8460.

3. Eureka Laboratories, Inc., Alternatives to Organic Solvent Degreasing, Report No. 77-E-01 (ARB A6-206-30) (May 1978).

4. U.S. Environmental Protection Agency, Control of Volatile Organic Emissions from Solvent Metal Cleaning, EPA 450/2-77-022 (November 1977).

5. Data provided by California Bureau of Automotive Repair.

PREPARED BY

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Table I
1987 Area Source Emissions
Activity: Services & Commerce
Process: Degreasing
Entrainment: Non Synthetic-Evap
Dimn: Stoddard
CES: 46847
Process Rate Unit: Installation

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons /Year)
GBV	ALPINE	0	0.17	0.00	0.00	0.00	0.00
	INYO	72	21.45	0.00	0.00	0.00	0.00
	MONO	35	10.52	0.00	0.00	0.00	0.00
LC	LAKE	136	35.50	0.00	0.00	0.00	0.00
LT	EL DORADO	69	16.91	0.00	0.00	0.00	0.00
	PLACER	21	5.13	0.00	0.00	0.00	0.00
MC	AMADOR	72	16.42	0.00	0.00	0.00	0.00
	CALAVERAS	62	14.99	0.00	0.00	0.00	0.00
	EL DORADO	160	39.33	0.00	0.00	0.00	0.00
	MARIPOSA	21	5.67	0.00	0.00	0.00	0.00
	NEVADA	147	43.42	0.00	0.00	0.00	0.00
	PLACER	34	7.94	0.00	0.00	0.00	0.00
	PLUMAS	80	20.88	0.00	0.00	0.00	0.00
	SIERRA	4	1.04	0.00	0.00	0.00	0.00
	TUOLUMNE	130	31.42	0.00	0.00	0.00	0.00
NC	DEL NORTE	40	11.82	0.00	0.00	0.00	0.00
	HUMBOLDT	308	85.03	0.00	0.00	0.00	0.00
	MENDOCINO	195	49.09	0.00	0.00	0.00	0.00
	SONOMA	116	25.64	0.00	0.00	0.00	0.00
	TRINITY	41	11.94	0.00	0.00	0.00	0.00
NCC	MONTEREY	508	114.60	0.00	0.00	0.00	0.00
	SAN BENITO	46	11.27	0.00	0.00	0.00	0.00
	SANTA CRUZ	415	99.48	0.00	0.00	0.00	0.00
NEP	LASSEN	71	19.42	0.00	0.00	0.00	0.00
	MODOC	26	6.21	0.00	0.00	0.00	0.00
	SISKIYOU	158	44.51	0.00	0.00	0.00	0.00
SC	LOS ANGELES	12176	3005.68	0.00	0.00	0.00	0.00
	ORANGE	3706	812.55	0.00	0.00	0.00	0.00
	RIVERSIDE	1032	286.27	0.00	0.00	0.00	0.00
	SAN BERNARDINO	1591	368.11	0.00	0.00	0.00	0.00
SCC	SAN LUIS OBISPO	438	116.87	0.00	0.00	0.00	0.00
	SANTA BARBARA	598	146.28	0.00	0.00	0.00	0.00
	VENTURA	956	209.49	0.00	0.00	0.00	0.00
SD	SAN DIEGO	3282	344.24	0.00	0.00	0.00	0.00
SED	IMPERIAL	148	29.06	0.00	0.00	0.00	0.00
	KERN	122	25.60	0.00	0.00	0.00	0.00
	LOS ANGELES	172	40.10	0.00	0.00	0.00	0.00
	RIVERSIDE	421	116.82	0.00	0.00	0.00	0.00
	SAN BERNARDINO	380	88.04	0.00	0.00	0.00	0.00
SF	ALAMEDA	2127	501.64	0.00	0.00	0.00	0.00
	CONTRA COSTA	423	74.82	0.00	0.00	0.00	0.00
	MARIN	173	30.66	0.00	0.00	0.00	0.00
	NAPA	64	11.31	0.00	0.00	0.00	0.00
	SAN FRANCISCO	474	83.58	0.00	0.00	0.00	0.00
	SAN MATEO	1086	268.94	0.00	0.00	0.00	0.00
	SANTA CLARA	2335	529.92	0.00	0.00	0.00	0.00
	SOLANO	340	77.11	0.00	0.00	0.00	0.00
	SONOMA	186	32.85	0.00	0.00	0.00	0.00
SJV	FRESNO	1238	298.86	0.00	0.00	0.00	0.00
	KERN	759	158.64	0.00	0.00	0.00	0.00
	KINGS	166	36.33	0.00	0.00	0.00	0.00
	MADERA	157	38.34	0.00	0.00	0.00	0.00
	MERCED	273	57.75	0.00	0.00	0.00	0.00
	SAN JOAQUIN	688	144.60	0.00	0.00	0.00	0.00
	STANISLAUS	519	96.58	0.00	0.00	0.00	0.00
	TULARE	514	128.67	0.00	0.00	0.00	0.00
SV	BUTTE	403	94.17	0.00	0.00	0.00	0.00
	COLUSA	43	329.34	0.00	0.00	0.00	0.00
	GLENN	73	17.24	0.00	0.00	0.00	0.00
	PLACER	256	59.46	0.00	0.00	0.00	0.00
	SACRAMENTO	1442	170.12	0.00	0.00	0.00	0.00
	SHASTA	388	102.01	0.00	0.00	0.00	0.00
	SOLANO	60	13.70	0.00	0.00	0.00	0.00
	SUTTER	126	30.38	0.00	0.00	0.00	0.00
	TEHAMA	120	23.07	0.00	0.00	0.00	0.00
	YOLO	249	56.25	0.00	0.00	0.00	0.00
	YUBA	96	24.24	0.00	0.00	0.00	0.00
TOTAL		42767	9829.49	0.00	0.00	0.00	0.00

Fraction of Reactive Organic Gases (FROG): 1.0000
(Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .9600
(PM10 Emissions = PM X FRPM10)

Table II
1987 Area Source Emissions
Activity: Services & Commerce
Process: Degreasing
Entrainment: Synthetic-Evap
Dimn: Commercial/Institutional
CES: 46854
Process Rate Unit: Installation

AB	County	Process Rate	TOG Emis. (Tons / Year)	CO Emis. (Tons / Year)	NOX Emis. (Tons / Year)	SOX Emis. (Tons / Year)	PM Emis. (Tons / Year)
GBV	ALPINE	0	0.00	0.00	0.00	0.00	0.00
	INYO	0	0.00	0.00	0.00	0.00	0.00
	MONO	0	0.00	0.00	0.00	0.00	0.00
LC	LAKE	5	1.15	0.00	0.00	0.00	0.00
LT	EL DORADO	3	0.12	0.00	0.00	0.00	0.00
	PLACER	1	0.00	0.00	0.00	0.00	0.00
MC	AMADOR	2	0.00	0.00	0.00	0.00	0.00
	CALAVERAS	3	0.12	0.00	0.00	0.00	0.00
	EL DORADO	7	0.12	0.00	0.00	0.00	0.00
	MARIPOSA	1	0.00	0.00	0.00	0.00	0.00
	NEVADA	0	0.00	0.00	0.00	0.00	0.00
	PLACER	2	0.00	0.00	0.00	0.00	0.00
	PLUMAS	2	0.00	0.00	0.00	0.00	0.00
	SIERRA	0	0.00	0.00	0.00	0.00	0.00
	TUOLUMNE	6	0.14	0.00	0.00	0.00	0.00
NC	DEL NORTE	0	0.00	0.00	0.00	0.00	0.00
	HUMBOLDT	7	0.12	0.00	0.00	0.00	0.00
	MENDOCINO	9	0.24	0.00	0.00	0.00	0.00
	SONOMA	12	0.25	0.00	0.00	0.00	0.00
	TRINITY	0	0.00	0.00	0.00	0.00	0.00
NCC	MONTEREY	0	0.00	0.00	0.00	0.00	0.00
	SAN BENITO	3	0.12	0.00	0.00	0.00	0.00
	SANTA CRUZ	32	0.64	0.00	0.00	0.00	0.00
NEP	LASSEN	0	0.00	0.00	0.00	0.00	0.00
	MODOC	1	0.00	0.00	0.00	0.00	0.00
	SISKIYOU	2	0.00	0.00	0.00	0.00	0.00
SC	LOS ANGELES	892	19.42	0.00	0.00	0.00	0.00
	ORANGE	316	6.94	0.00	0.00	0.00	0.00
	RIVERSIDE	0	0.00	0.00	0.00	0.00	0.00
	SAN BERNARDINO	107	2.35	0.00	0.00	0.00	0.00
SCC	SAN LUIS OBISPO	12	0.25	0.00	0.00	0.00	0.00
	SANTA BARBARA	29	0.66	0.00	0.00	0.00	0.00
	VENTURA	0	0.00	0.00	0.00	0.00	0.00
SD	SAN DIEGO	687	15.00	0.00	0.00	0.00	0.00
SED	IMPERIAL	14	0.36	0.00	0.00	0.00	0.00
	KERN	12	0.25	0.00	0.00	0.00	0.00
	LOS ANGELES	12	0.24	0.00	0.00	0.00	0.00
	RIVERSIDE	0	0.00	0.00	0.00	0.00	0.00
	SAN BERNARDINO	25	0.49	0.00	0.00	0.00	0.00
SF	ALAMEDA	240	5.11	0.00	0.00	0.00	0.00
	CONTRA COSTA	47	1.09	0.00	0.00	0.00	0.00
	MARIN	19	0.36	0.00	0.00	0.00	0.00
	SAN FRANCISCO	53	1.09	0.00	0.00	0.00	0.00
	SAN MATEO	96	2.19	0.00	0.00	0.00	0.00
	SANTA CLARA	216	4.74	0.00	0.00	0.00	0.00
	SOLANO	12	0.36	0.00	0.00	0.00	0.00
	SONOMA	21	0.36	0.00	0.00	0.00	0.00
SJV	FRESNO	75	1.61	0.00	0.00	0.00	0.00
	KERN	74	161.70	0.00	0.00	0.00	0.00
	KINGS	13	0.35	0.00	0.00	0.00	0.00
	MADERA	8	0.13	0.00	0.00	0.00	0.00
	MERCED	23	0.49	0.00	0.00	0.00	0.00
	SAN JOAQUIN	58	1.32	0.00	0.00	0.00	0.00
	STANISLAUS	56	1.25	0.00	0.00	0.00	0.00
	TULARE	29	0.66	0.00	0.00	0.00	0.00
SV	BUTTE	22	0.49	0.00	0.00	0.00	0.00
	COLUSA	2	0.00	0.00	0.00	0.00	0.00
	GLENN	1	0.00	0.00	0.00	0.00	0.00
	PLACER	13	0.37	0.00	0.00	0.00	0.00
	SACRAMENTO	84	1.83	0.00	0.00	0.00	0.00
	SHASTA	11	0.25	0.00	0.00	0.00	0.00
	SOLANO	0	0.00	0.00	0.00	0.00	0.00
	SUTTER	5	0.11	0.00	0.00	0.00	0.00
	TEHAMA	2	0.00	0.00	0.00	0.00	0.00
	YOLO	15	0.39	0.00	0.00	0.00	0.00
	YUBA	5	0.11	0.00	0.00	0.00	0.00
TOTAL		3404	235.34	0.00	0.00	0.00	0.00

Fraction of Reactive Organic Gases (FROG): .2500
(Reactive Organic Gases (ROG) Emissions = TOG X FROG)
Fraction of PM10 (FRPM10): .9600
(PM10 Emissions = PM X FRPM10)